Sideband splatter is noise-like in that it has a very broad spectrum. The spectral frequency components of the out-of-channel components are generated by non-linear amplification of an 8-VSB DTV signal whose bandwidth is well contained within 6 MHz. This non-linearity causes Inter-Modulation (IM) products to be generated as illustrated in **Figure B-1**. The spectral density of this sideband splatter closely matches the RF Mask proposed by the FCC in its Fifth Further Notice of Proposed Rule Making released May 20, 1996. In this case, the dominant IM products are third order IM products. These products are the difference between the second harmonic of one signal component and the fundamental frequency of a second frequency component of the 8-VSB signal. Both frequency components are simultaneously present to generate the IM products. Therefore, the fact that the 8-VSB signal is noise-like in its spectrum is well known and will be assumed here.

A number of spectrum plots were made to understand the nature of the artifact attributed to sideband splatter into the NTSC channel from 8-VSB (or any digital TV) signal from adjacent channels. The instrumentation used is a Tektronix VM-700 which can provide spectrum analysis of baseband NTSC video signals. A Tektronix 1450 Precision NTSC Demodulator was used to recover the baseband video signal.

A reference plot of the noise spectral power density across the video frequency band without any 8-VSB signal on an adjacent channel is shown in **Figure B-2**. This plot represents the noise floor of the measuring instrumentation. The Noise Floor is virtually flat at about -60 dB to 4 MHz. It is important to note that the Noise Weighting Filter is not in use. The Noise Weighting Filter emulates the frequency characteristics of human vision which is less affected by random noise of high video frequencies relative to lower frequency spectral noise components. **Figure B-3** illustrates the effect of the Noise Weighting Filter in significantly attenuating the higher video frequencies.

**Figure B-4** shows the unweighted spectrum of the baseband video signal when the 8-VSB signal occupies the channel Upper Adjacent to the NTSC signal. Note that the noise power density at low video frequencies is the same as in the reference plot of **Figure B-2**. The noise power density increases with frequency by approximately 10 dB up to the limiting frequency of the instrumentation. However, the application of the Noise Weighting Filter as shown in **Figure B–5** illustrates that the high frequency noise is considerably attenuated by the visual properties of the human vision system.

In the case of interference from an 8-VSB signal on the Lower Adjacent channel, the spectral power density is higher at low video frequencies as illustrated in **Figure B-6**. However, **Figure B-7** shows that when the Noise Weighting Filter is applied, the noise at the low video frequencies remain. The result is primarily luminance noise whose coarse structure is difficult to ignore by the viewer.

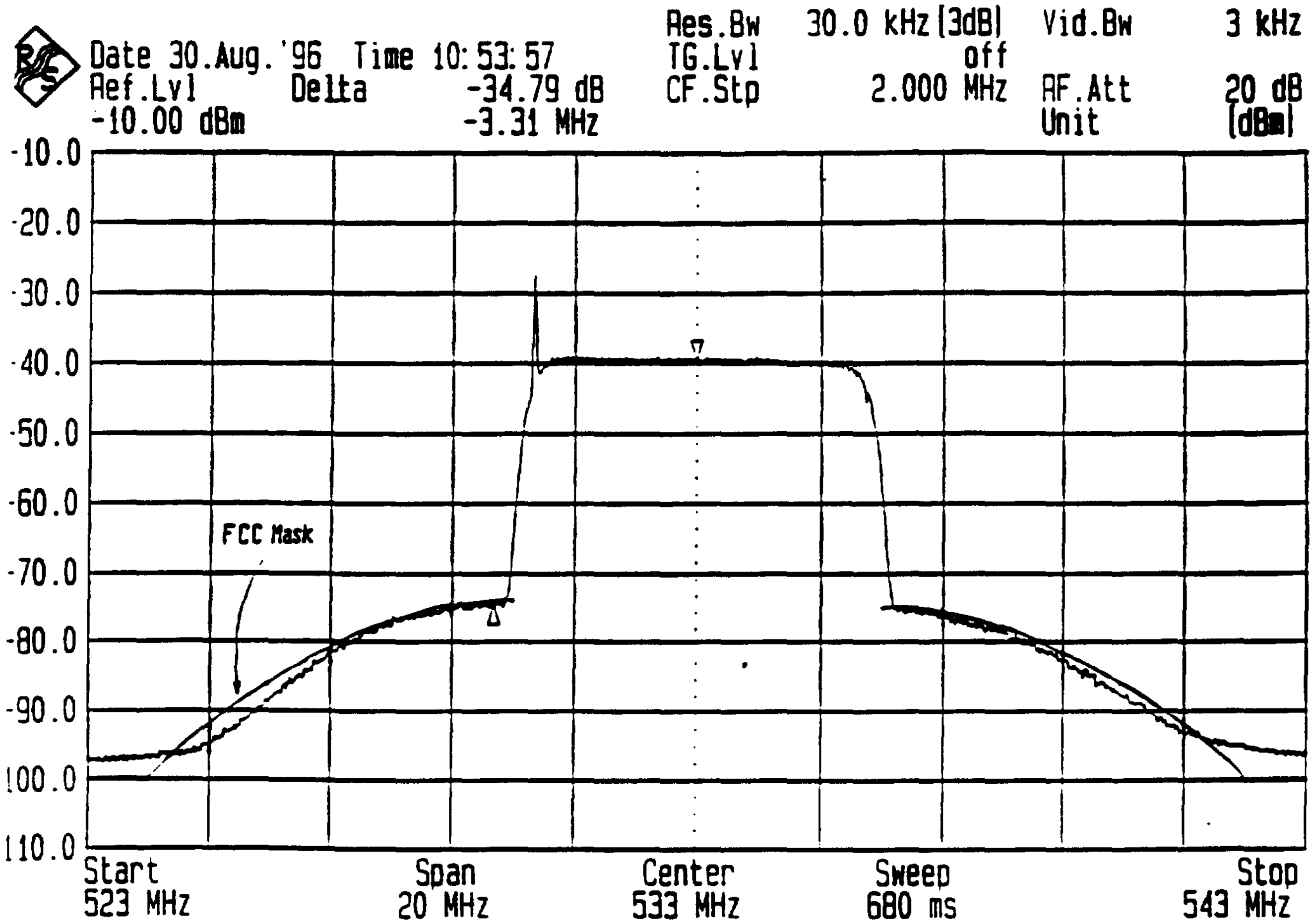


**Figure B-1** -- Spectrum plot showing the 8-VSB DTV channel out-of-band emissions which emulate the maximum sideband splatter permissible by the proposed FCC RF mask. (Note that at the frequency limits of this plot, the signal spectrum may be at the noise floor of the instrument.)

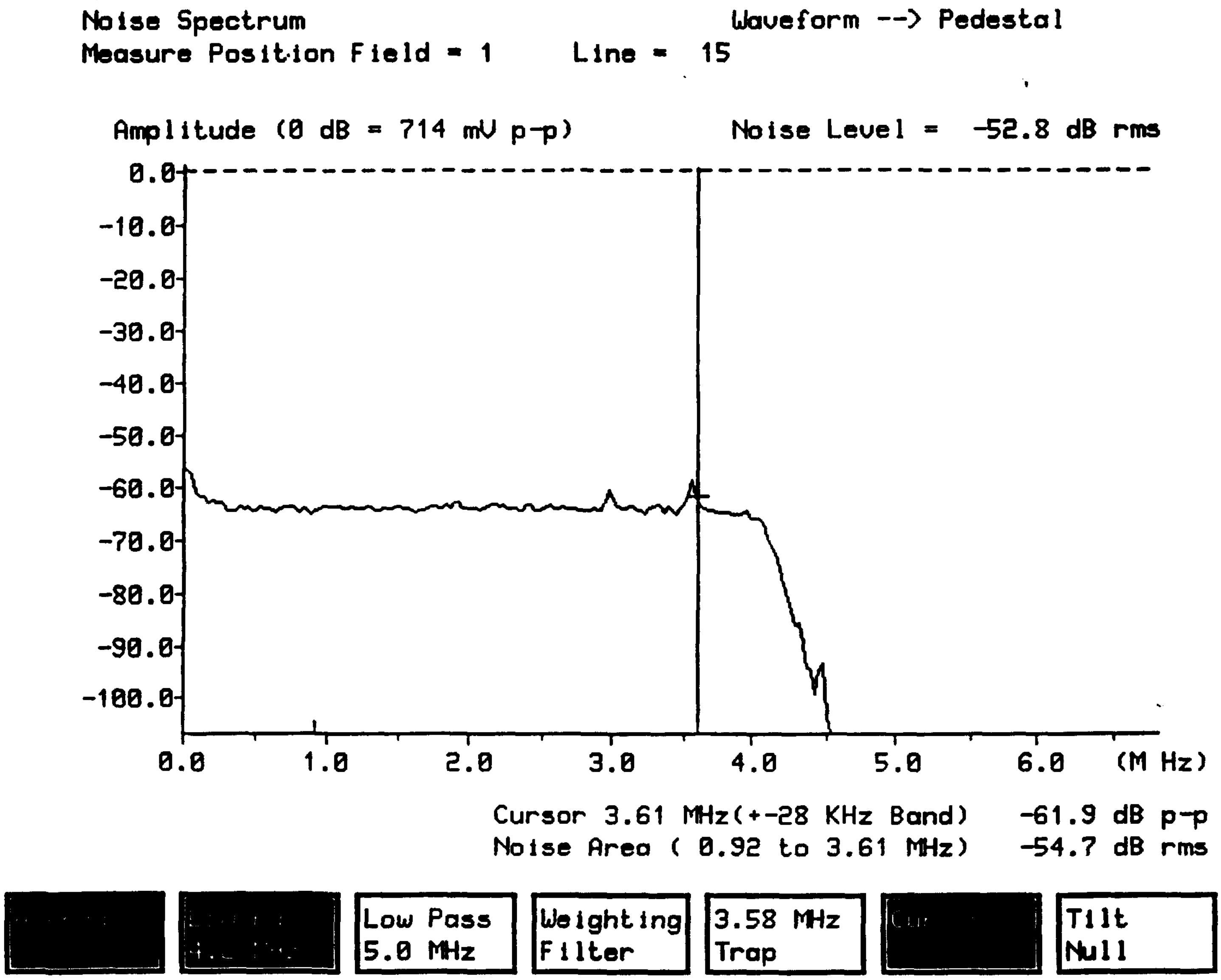


**Figure B-2** – Unweighted noise spectrum plot for an NTSC channel without an adjacent 8-VSB DTV channel illustrating the instrumentation noise reference floor.

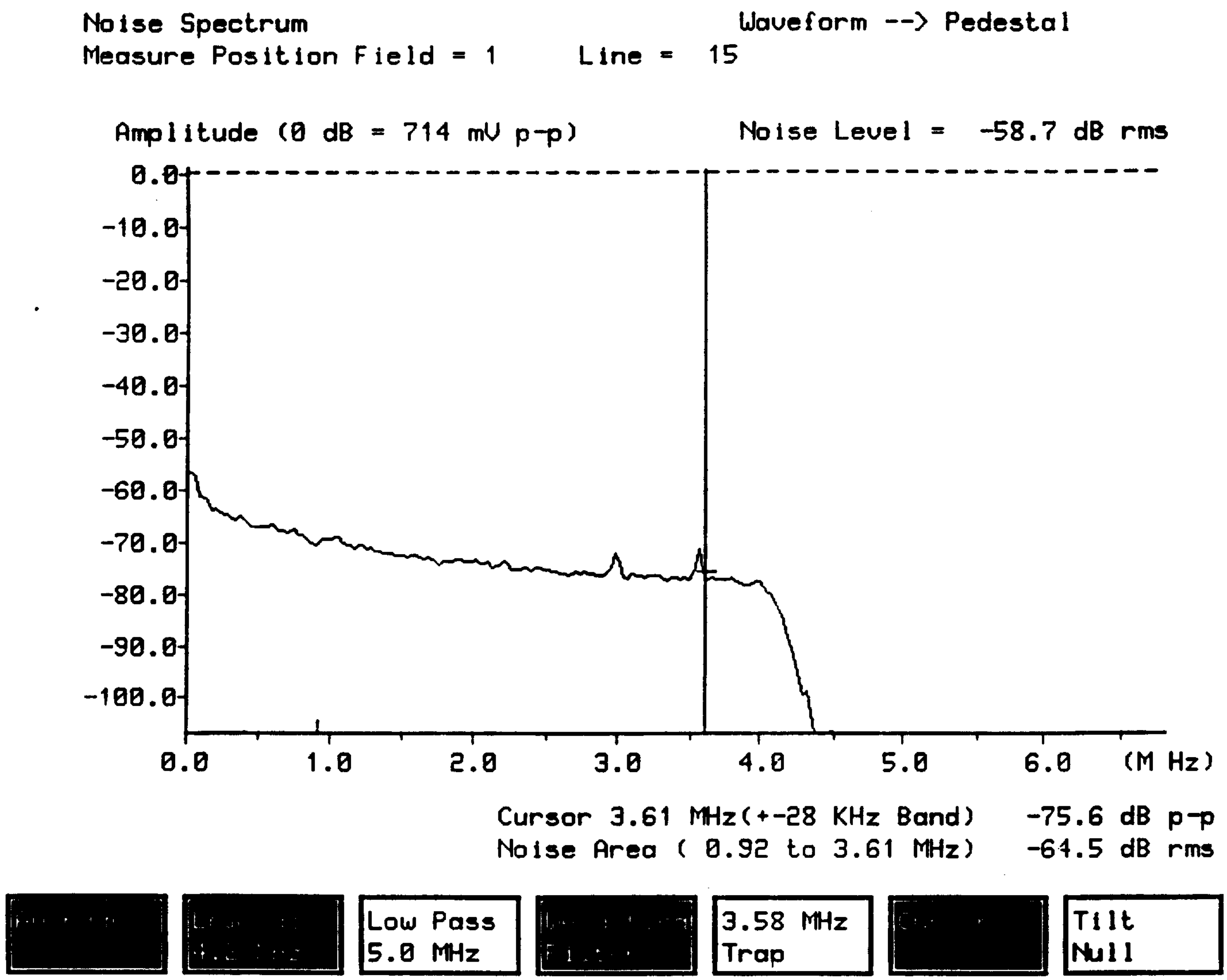


**Figure B-3** -- Noise spectrum plot for an NTSC channel without an adjacent DTV channel using the Noise Weighting Filter to emulate the frequency characteristics of the human vision system.

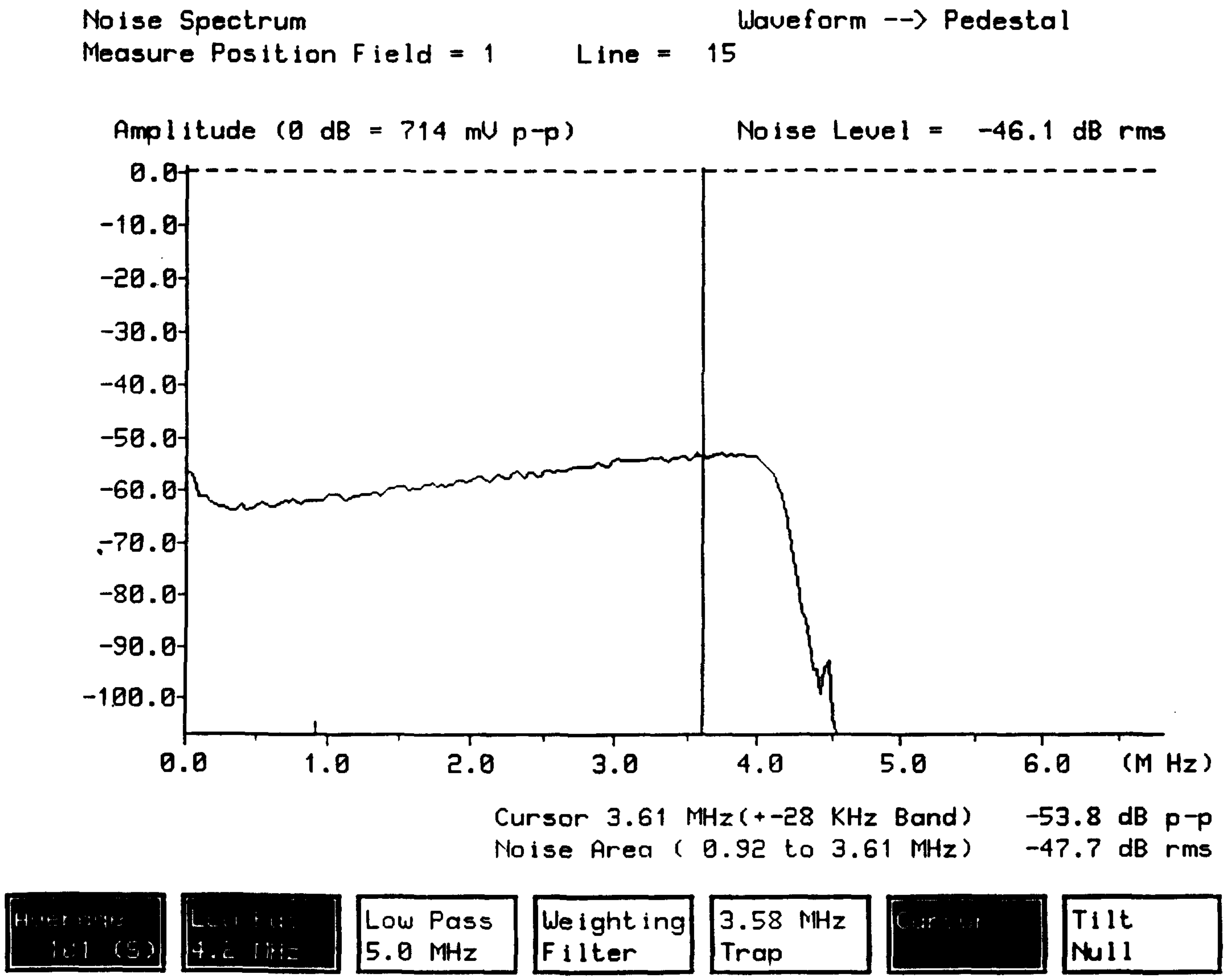


**Figure B-4** – Unweighted noise spectrum plot for an NTSC channel with an Upper Adjacent 8-VSB DTV channel showing an increase in high frequency noise.

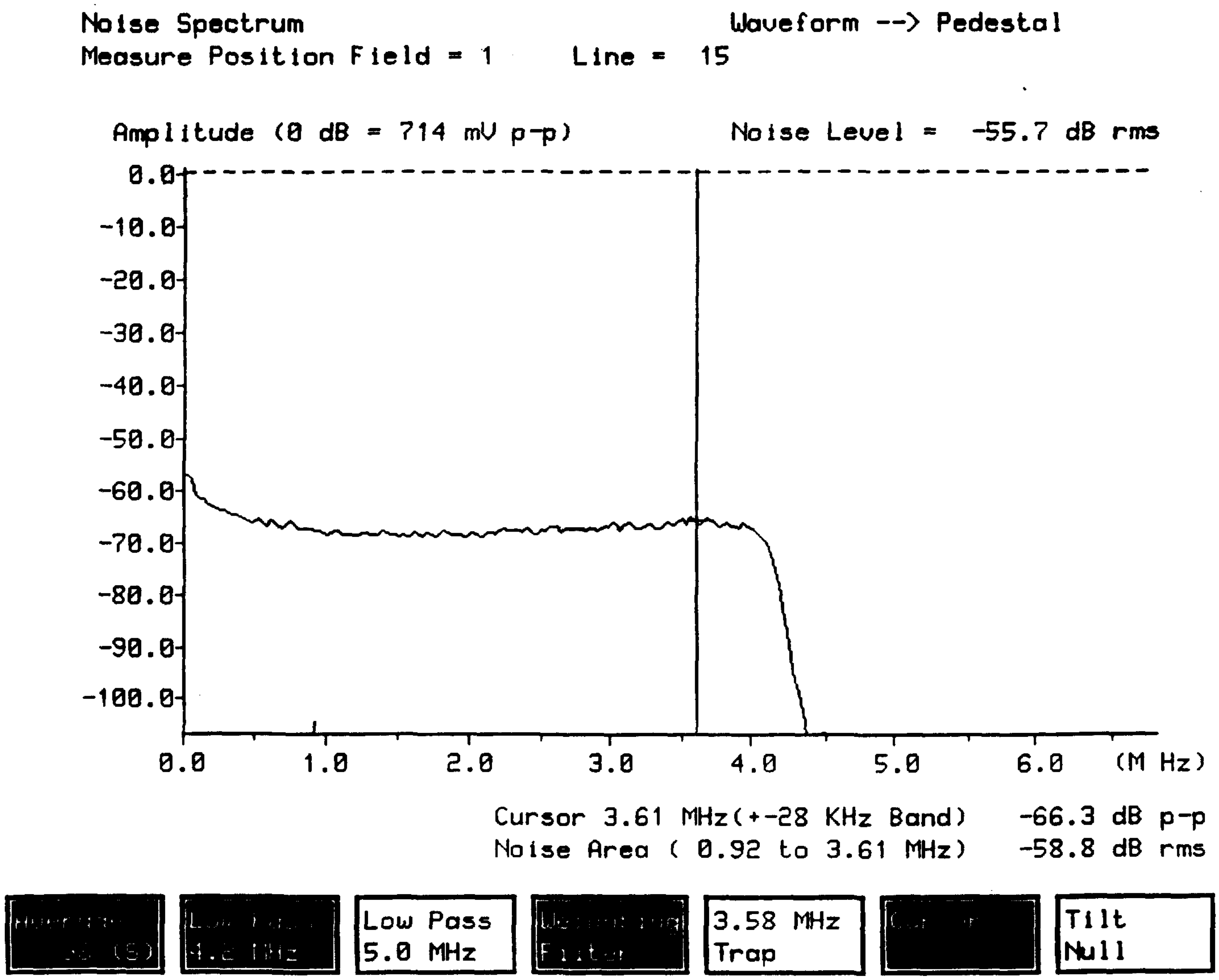


**Figure B-5** – Noise spectrum plot for an NTSC channel with an Upper Adjacent DTV channel using the Noise Weighting Filter to emulate the frequency characteristics of the human vision system. The high frequency noise components are reduced to the reference level.

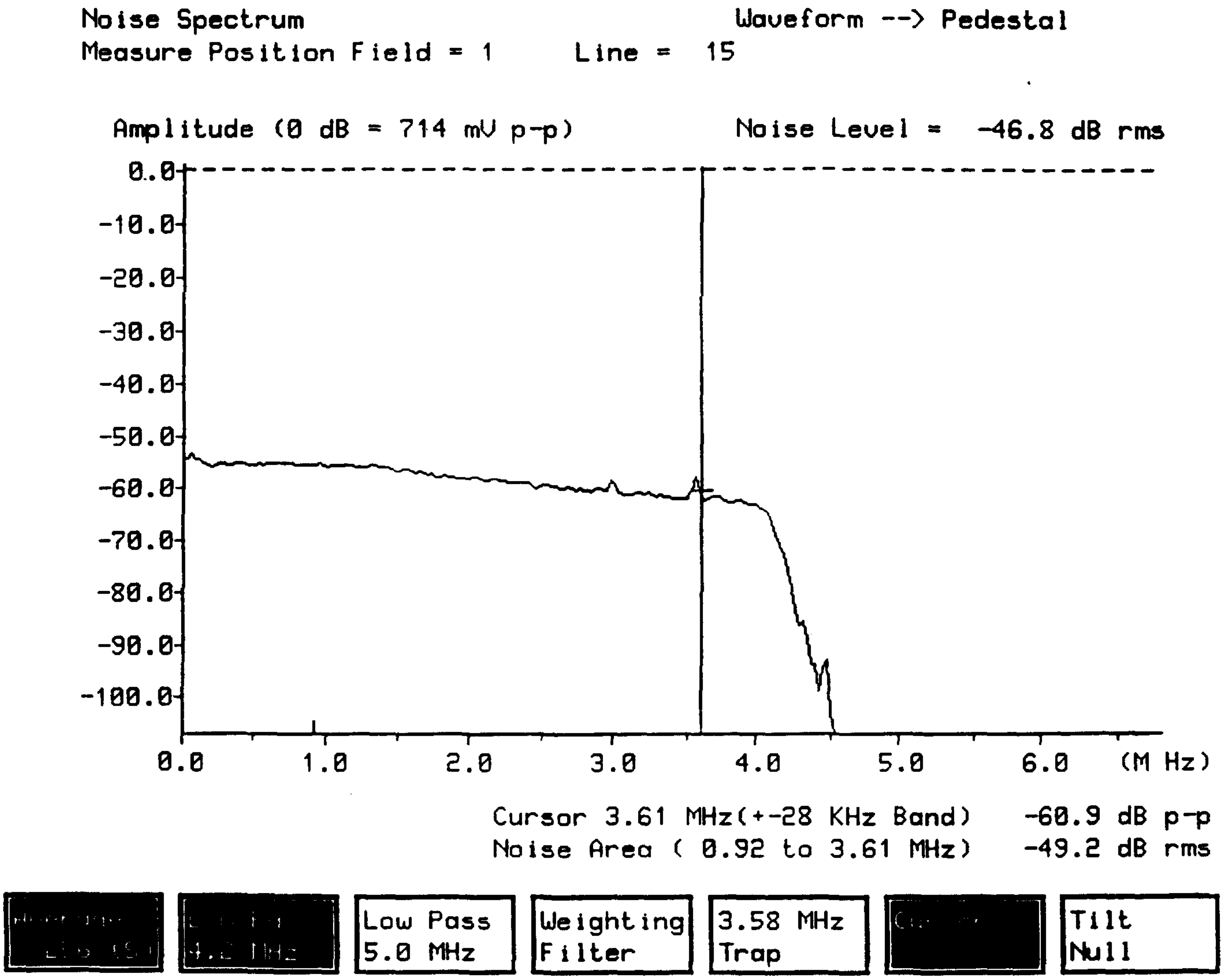


**Figure B-6** -- Unweighted noise spectrum plot for an NTSC channel with a Lower Adjacent 8-VSB DTV channel showing an increase in low frequency noise.

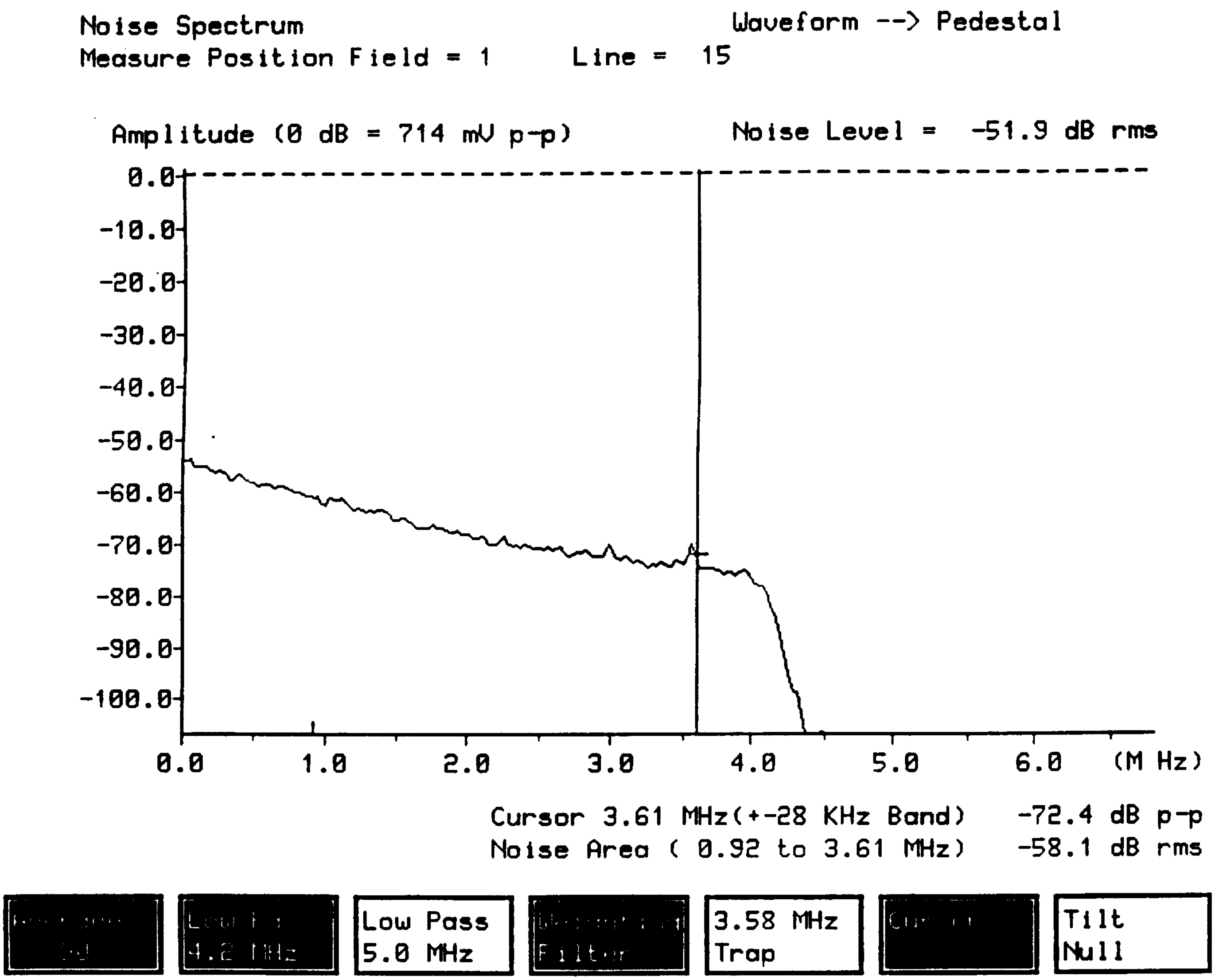


**Figure B-7** -- Noise spectrum plot for an NTSC channel with a Lower Adjacent DTV channel using the Noise Weighting Filter to emulate the frequency characteristics of the human vision system. The low frequency noise components are not reduced and result in luminance noise whose coarse structure is difficult to ignore by the viewer.

# Appendix C

## Measurement of Out-of-Channel Spectral Power Density

The FCC has proposed in its Fifth Further Notice of Proposed Rule Making (NPRM) an RF mask for Digital Television (DTV). The mask defines the maximum spectral power density limits that can be radiated into an adjacent 6 MHz channel by a DTV transmitter. The mask is defined mathematically in terms of relative attenuation A of the power density in dB outside of the assigned DTV channel in terms of frequency $\Delta f$ (in MHz) from the nearest DTV channel edge over the range from zero to 6 MHz:

$$A = 35 \text{ dB} + ( \Delta f^2 / 1.44 ) \text{ dB}$$

The mask results in an attenuation of 35 dB as the upper limit at the channel edges and 60 dB at 6 MHz from the channel edges. In addition, the FCC proposes that the measurement be made with a resolution bandwidth of 500 kHz.

The Advanced Television Technology Center, Inc. (ATTC) proposes a more accurate method of measurement of the out-of-channel spectral power density using a resolution bandwidth of 30 kHz. In addition, the ATTC recommends that the spectral measurement should not be made at the DTV channel edges.

## I. A 500 kHz resolution bandwidth is not appropriate for the measurement of out-of-channel spectral power density.

The ATTC proposes that 30 kHz be specified as the resolution bandwidth for the purpose of measuring DTV signals. **Figure C-1** illustrates a spectrum plot of an 8-VSB signal made with a resolution bandwidth of 30 kHz. The spectrum of the signal is well contained within a 6.0 MHz bandwidth and measures 25 dB down at the channel edges. This spectrum plot provides a good approximation of the actual occupied bandwidth since the resolution bandwidth is small in comparison with the 6 MHz bandwidth. The same signal measured with a nominal 500 kHz resolution bandwidth (506.5 kHz actual) is illustrated in **Figure C-2**. The apparent signal bandwidth, measured at the same reference point (25 dB down), is approximately 7.3 MHz. The spectrum plot clearly demonstrates that the proposed 500 kHz resolution bandwidth does not accurately represent the actual occupied spectrum.

Further evidence is provided by a comparison of spectrum plots in **Figures C-3 and C-4**. Non-linear distortion has been deliberately introduced. The out-of-channel Inter-Modulation (IM) products correspond with the limits proposed by the FCC in the aforesaid NPRM as shown in **Figure C-3**. The spectrum plot uses a resolution bandwidth of 30.0 kHz [3 dB] as is our recommendation. The spectrum plot of the same 8-VSB signal with the same level of distortion products, but with a nominal 500 kHz resolution bandwidth is illustrated in **Figure C-4**. The plot indicates a much higher level of spectral power density at the channel edges. These levels cannot be attributed to the IM products present, but are a result of the signal spectrum being spread by the wide bandwidth resolution employed in the measurement.

## II. Spectral measurements should not be made at the DTV channel edges.

In the referenced NPRM, the FCC proposed to measure the spectral power density at the DTV channel edges. The ATTC wishes to comment that it would be better to make such measurements at frequencies just outside the DTV channel (e.g., at 0.25 MHz from the DTV channel edge). Two reasons are present to support this recommendation:

(1) The purpose of the measurement is to determine the out-of-channel IM products. The actual extent of the out-of-channel IM products can be more clearly discerned by a measurement made just outside the DTV channel where the DTV spectrum itself is negligible compared with any IM product. **Figure C-4** shows that when the marker is set to 0.31 MHz below the lower edge, the spectral power density is 34.76 dB below the center of the DTV channel.

(2) The steep slope of the spectrum at the channel edges will yield significantly different results if the spectrum is offset with the channel. This offset is proposed by the FCC in the aforesaid NPRM. The spectrum of the DTV signal may be offset with the DTV channel by ± 10 kHz in order to protect an NTSC signal on the lower adjacent channel from interference.

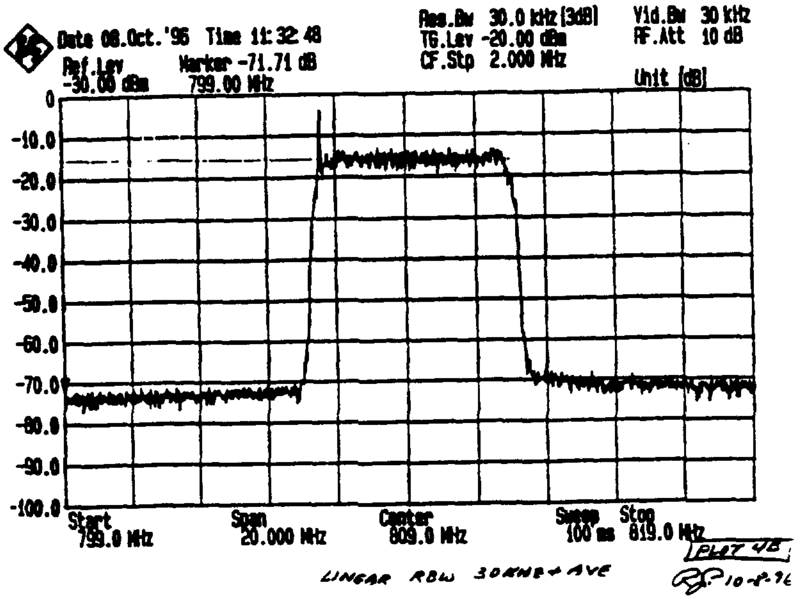


**Figure C-1.** Spectrum plot of a digital TV signal using a 30 kHz resolution bandwidth to accurately measure the actual bandwidth occupied.

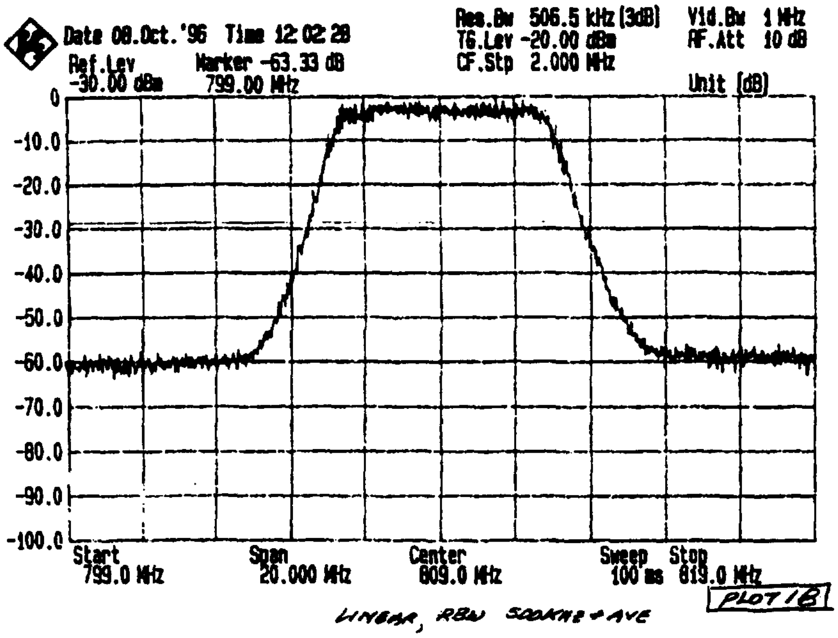


**Figure C-2.** Spectrum plot the same digital TV signal in **Figure C-1** using a 506.5 kHz resolution bandwidth illustrating the misleading result.

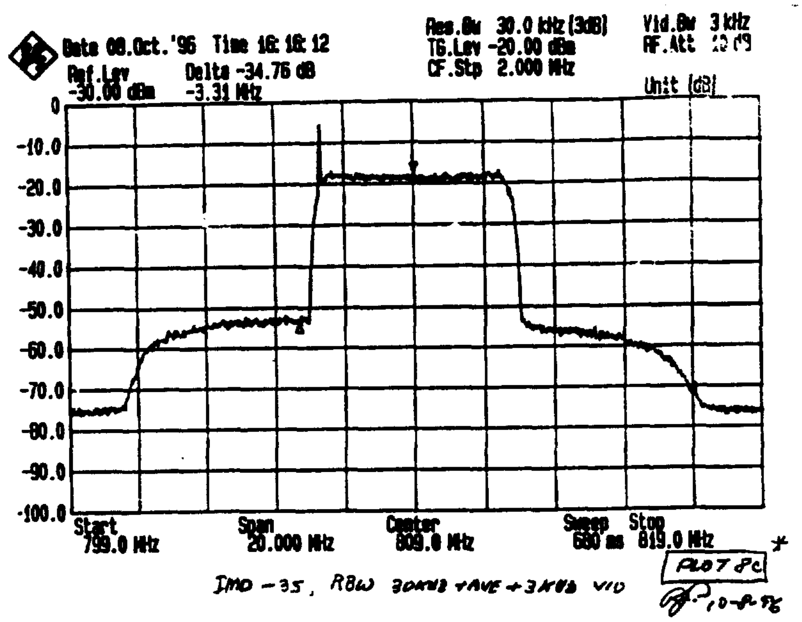


**Figure C-3.** Spectrum plot of a digital TV signal with Inter-Modulation products present in the adjacent channel. A 30 kHz resolution bandwidth accurately measures the actual bandwidth distribution.

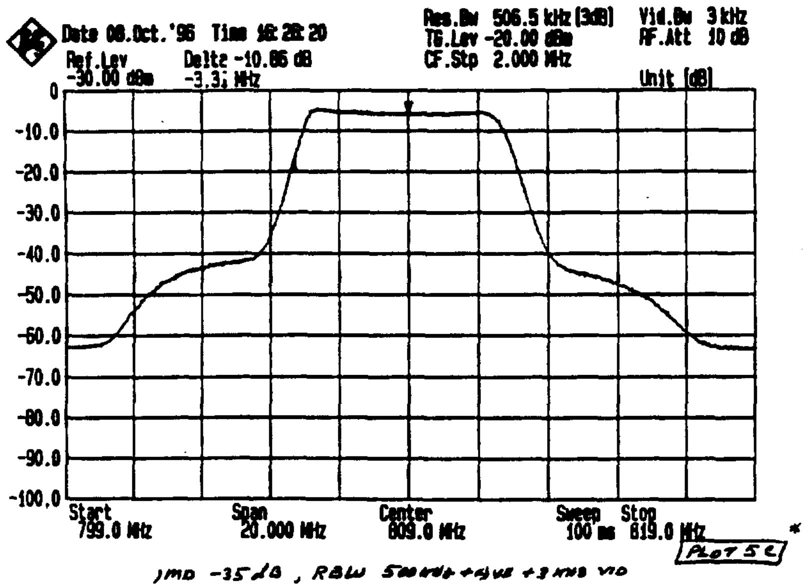


**Figure C-4.** Spectrum plot of the same digital TV signal as **Figure C-3** with Inter-Modulation products present in the adjacent channel using a 506.5 kHz resolution bandwidth. The wide resolution bandwidth incorrectly represents the actual out-of-channel IM products.